Silica	38·830
Alumina	13·250
Protoxide of iron	13·830
Peroxide of iron	4·335
Lime	3·925
Magnesia	4·180
Potash	·422
Soda	·971
Carbonic acid	9·320
Water	11·010
	100·073

Although Professor Jukes expresses himself as confident of the origin of this substance, he nowhere had an opportunity of examining it in contact with basalt previous to its alteration. The presence of carbonic acid and water he ascribes to subsequent infiltration.

XV. "Results of Magnetical Observations made in Little Namaqualand during a part of the Months of April and May, 1874." By E. J. Stone, M.A., F.R.S. Received June 11, 1875.

An eclipse of the sun was to occur on April 16, 1874, which would be total throughout Little Namaqualand. I made arrangements for a visit to this country to observe the eclipse. The country is one rarely visited. I was not aware that any determinations of the magnetic elements had been made there, except a few of the variation by the Admiralty surveyors at one or two points along the coast. It appeared to me desirable that the opportunity afforded by my visit to observe the eclipse should not be lost of securing magnetical observations at several stations in Namaqualand. An application was made to the Colonial Government for some assistance. An ox-waggon was required for the transit of the magnetical equipment and of a wooden building which had been prepared to protect the instruments and the observers whilst at work. The sum asked for was sixty pounds. The request thus made was, however, refused, although with great courtesy and apparent reluctance, from a supposed difficulty in passing such a grant through Parliament. I was, however, most unwilling to abandon the idea of making these magnetical observations. When the facts of the case became known, I received offers of assistance from some gentlemen in Namaqualand, and His Excellency Sir Henry Barkly, K.C.B. &c., kindly interested himself in the matter and afforded me all the facilities in his power. I determined therefore to carry out, in a somewhat modified form, the scheme of observations which I had arranged. The wooden building was left behind. I found that good observations could be made without cover of

any kind for the instruments or the observer, although at a considerable cost in time and in the comfort of those engaged upon the work. The greatest trouble arises from the action of the wind upon the instruments, more particularly upon the dip-instrument; but by patiently awaiting opportunities the injurious effects arising from this cause can be very nearly, if not quite eliminated. I decided also, after some hesitation, to take no assistant with me. I was anxious to avoid unnecessary expense, and to obtain as great freedom for moving about the country as possible. I only absolutely required some one to enter the times from a chronometer to the nearest half-second; and I found, after a careful series of experiments upon the point, that my wife could do this without any difficulty. The probable error of these time determinations does not appear to exceed three tenths of a second; and it would be very difficult, with a skilled assistant, to obtain, under the circumstances of these observations, a much greater degree of accuracy. The instrumental equipment consisted of:—a "Dip," by Dover; a "Unifilar," variation, and intensity instrument combined, by Elliott Brothers; a five-inch Theodolite, for the determination of the latitudes, local times, and absolute azimuths of marks; aneroid barometer; thermometer; and a pocket chronometer beating half-seconds. With only two persons and this instrumental equipment, it was found possible to move freely about the country in a Cape cart, and with comparative luxury in a waggon.

I knew that a chronometer could not be trusted to carry accurate time over such a country as Namaqualand without, at least, special appliances, which were not available to me under the circumstances of the case. I arranged therefore for the determination of local time with the theodolite, and for the fixing of the absolute azimuths of the marks with the same theodolite immediately before or after the determinations of local time. The ill effects of a trip or stoppage of the chronometer was thus eliminated. This precaution was found necessary. The chronometer has stopped and then gone on again on several occasions from the dreadful shaking of the carts or waggons over the rocky roads, and has on some occasions tripped some seconds from merely being carried about in the pocket or hand. The chronometer dead-beat escapement does not appear at all well fitted for rough work of the kind, and a good lever escapement would be much preferable. The chronometer used has had a very steady rate when not moved about, and has not much changed that rate, when at rest, from the effects of the journey. The greatest practical inconvenience experienced in the use of the instruments was the occasional breakage of the suspension-threads and the loss of time in getting the new threads out of torsion. After several accidents of the kind, I used three instead of two threads of suspension; but the torsion was inconveniently large, and the loss of time in getting the threads out of torsion considerable. These three threads were only used at the Orange-River station and on the return to Port Nolloth. The time of vibration

of the magnet was found as follows :—The passage of the line of reference in the needle over the wire of the observing-telescope was noted at every tenth complete vibration passing right and passing left. If t_1, t_2, t_3, and t_4 are n observed times of these passages right, we have for the time of a semivibration

$$\tau=\frac{3}{10}\frac{1}{n+1}\left\{\frac{2}{n(n-1)}\left[0\times t_1+1\times t_2+2\times t_3+\ldots.+(n-1)t_n\right]\right.$$

$$\left.-\left[\frac{t_1+t_2+\ldots.+t_n}{n}\right]\right\},$$

and a similar expression for the time from the passages left.

The probable error of the mean of these two determinations can be shown to be

$$\frac{e}{10}\sqrt{\frac{3}{2}\frac{1}{(n-1)n(n+1)}},$$

where e is the probable error of a single time determination.

In the Namaqualand observations n was usually 6. If, therefore, $e=0^s\cdot3$, we have for the probable error in the times of vibration

$$0\cdot0025.$$

I think this error rather in excess than defect.

The Dip Observations consisted of a bisection of the upper and lower ends of the needle after each lift of the needle; both microscopes were read each time. There were never less than four of these independent lifts in each position; a complete dip therefore consisted of at least sixty-four independent bisections of the ends of the needle and of thirty-two independent lifts of the needle from the agate planes. A great deal of time was consumed in making one of these dips in the open air, on account of the disturbances of the instrument by the wind. In the zenith-distance observations of the sun for local time, and azimuth observations for the determination of the absolute azimuths of the marks, both limbs of the sun in reversed positions of the theodolite were always taken. The differences between the azimuths of these marks, usually two, and the azimuthal reading for the magnetic meridian were taken with the Elliott instrument. The means of the results obtained from the variation-needle, which allows of reversed suspension, were alone used; but the reading for the magnetic axis of the vibration-magnet, which is well adjusted, was usually taken as a check. To save time the deflection observations were only made at the distance of one foot, except for the Port Nolloth station. The small correction to the results thus found, usually determined by a second set of deflections at 1·3 foot, has been obtained from the Port Nolloth observations and other determinations at the observatory. The longitudes of the stations are only very rough approximations. No attempt was made to fix them with any greater accuracy than

that required for the necessary interpolations of the sun's declination. I may perhaps be permitted to mention that the observations whose results are contained in the present paper could hardly have been made had it not been for the assistance afforded me by E. J. Carson, Esq., Manager, and R. T. Hall, Esq., C.E., Engineer, of the Cape Copper Company. My thanks are due to them for a thoughtful kindness which offered every facility for my work, and yet rendered a working trip into a somewhat wild country one of great enjoyment.

Port Nolloth.

Station not far from the Cemetery, Sandy Velt.
Longitude $1^h\ 7^m\ 28^s$. South latitude 29° 15′ 30″.

Dip Observations. Needle A_2 B, Dover.

		° ′ ″
1874, April 10, 11^h.	A_2 South	53 19 30
	A_2 North	53 26 3
	Dip .... =	53 22 46

The wind was very high at times during these observations; but the results appeared satisfactory.

1874, April 11, 10^h. Temperature 61°·2.

Deflections produced by the vibrating-magnet:—

	° ′ ″	
1·0 foot	10 56 43 10 57 7 10 55 52 10 57 3	u=10° 56′ 41″.
1·3 foot	4 56 3 4 59 42 4 56 33 5 1 7	u'=4° 58′ 21″.

April 11, $12^h\ 30^m$. Temperature 59°. $90p=2'$=torsion. $\tau_1=5^s{\cdot}05$, $\tau_2=5^s{\cdot}05$.

Wind so high that the observations had to be abandoned. These determinations have not been used.

Variation Observations.

1874, April 12, 10^h. Temperature 75°. $90p=2'\ 10''$. Correction for torsion insensible.

Readings for variation-magnet:—

	° ′ ″
Suspension direct	265 55 30
,, reversed	264 40 22
Azimuthal reading for magnetical meridian	265 17 56
Azimuthal reading for magnetical meridian with vibration-magnet..........................	265 18 5
Reading for southern mark	288 8 15
,, northern mark	261 20 35

The absolute azimuths of these marks determined on April 10 were as follows:—

	°	′	″
Azimuth of northern mark	147	8	22
" southern mark	6	4	33
Variation from northern mark	28	54	17
" southern mark	28	54	52
Variation, April 12, 10^h	28	54	35

Vibration Observations.

April 12, $11^h\ 20^s$. Temperature 72°. $90p=2'\ 10''$. $\tau_1=5^s{\cdot}0543$, $\tau_2=5^s{\cdot}0529$, $\tau=5^s{\cdot}0536$.

The changes of temperature were considerable; at times a cold damp mist passed over from the sea.

The latitude was determined on April 12, near noon, and found to be 29° 15′ 30″.

On my return to Port Nolloth I was detained six days waiting for the steamer, which lay outside the bar, but could not cross on account of rough weather. During the greater part of this time a dense damp mist prevailed that rendered observations impossible. I was, however, anxious to repeat, at least, the determination of the variation; and this was done on May 3, 3^h. The station was one rather nearer the sea than that first chosen.

Temperature 70°·2. $90p=10'\ 17''$. Correction $-0'\ 55''$.

Azimuthal reading for magnetical meridian, May 3, 3^h:—

	°	′	″
Suspension direct	319	17	24
" reversed	318	51	48

	°	′	″
Reading =	319	4	36
Torsion correction =		0	55
	319	3	41
Reading for mark	320	27	2

Excess of reading for mark .... 1° 23′ 21″

The azimuth of the mark was found as follows:—

	°	′	″
1874, May 3	152	26	49
May 5	152	26	41

The variation on May 3, 3^h=28° 56′ 36″. The results for Port Nolloth are therefore as follows:—

V = Variation = 28° 55′ 36″ { mean of results for April 12 and May 3.

X = Horizontal force = 4·4464

m = Magnetic moment = 0·4264

D = Dip = 53° 22′ 46″

F = Total force = 7·4540

Klipfontein Station.

Approximate longitude............ $1^h\ 10^m\ 45^s$
Approximate south latitude .... $29°\ 14'\ 15''$

This station was on a mountain-range about 3000 feet above the level of the sea. It was near Mr. Hall's cottage, but sufficiently removed from it to avoid all danger of disturbances from the iron in or about the buildings.

Dip Observations. Needle A_2 B, Dover.

		°	′	″
1874, April 14, 10^h.	A_2 South	53	15	35
	A_2 North	53	28	17
	Dip .... =	53	21	56

Variation Experiments.

April 15, $9^h\ 30^m$. Temperature 77°·2. Torsion correction insensible. Variation-magnet :—

	°	′	″
Azimuthal reading, suspension direct	90	52	42
,, ,, ,, reversed	92	8	20
Azimuthal reading for magnetic meridian........	91	30	31
Azimuthal reading for magnetic axis of vibration-magnet	91	28	0
Azimuthal reading for mark α	107	11	48
Azimuthal reading for mark β	352	49	17
Absolute azimuth of mark α	224	4	38
Absolute azimuth of mark β	109	42	7

Variation, 28° 23′ 21″ from α.
,, 28 23 21 from β.

The determinations of the absolute azimuths of the marks are as follows :—

				°	′	″
April 15, $6^h\ 54^m$	A.M.	Azimuth of	α =	224	5	42
,, 15, 4 49	P.M.	,,		224	3	49
,, 16, 7 22	A.M.	,,		224	5	10
,, 15, 4 49	P.M.	,,	β =	109	41	9
,, 16, 7 22	A.M.	,,		109	43	4

No direct determination of the latitude could be made under favourable circumstances at noon or equally distant from and near noon, on account of the only stand being occupied at these hours for the magnetical observations. It would appear, from the small discordance between the evening and morning determinations of the azimuth of the marks, that the adopted latitude is slightly in error. The mean of the evening and morning determinations should, however, be sensibly accurate, and has been adopted.

Vibrations.

Three sets were taken; the first two were observed at unequal intervals, and were made somewhat under difficulties. Some ostriches bore down upon the instrument and had to be continually driven from it. The mean of the first two sets, however, agrees very closely with the third.

From the first two sets $\tau = 5^s{\cdot}0608$.

The last set gave:—

1874, April 15, $11^h\,6^m$. Temperature $80^\circ{\cdot}2$. $90p = 3'\,53''$. $\tau_1 = 5^s{\cdot}0600$, $\tau_2 = 5^s{\cdot}0603$, or $\tau = 5^s{\cdot}0602$.

The value $\tau = 5^s{\cdot}0606$ has been adopted.

Deflections.

April 15, 3^h. Temperature $87^\circ{\cdot}2$.

$$\text{Distance 1·0 foot}\left\{\begin{array}{ccc} \overset{\circ}{10} & \overset{\prime}{48} & \overset{\prime\prime}{35} \\ 10 & 52 & 27 \\ 10 & 55 & 28 \\ 10 & 54 & 40 \end{array}\right\} u = 10^\circ\,52'\,48''.$$

Hence for the Klipfontein station we have:—

Variation..........	V=	28° 23′ 21″
Horizontal force	X=	4·4343
Magnetic moment ..	m=	0·4279
Dip	D=	53° 21′ 56″
Total force	F=	7·4312

The total eclipse of the sun was observed from this station on April 16. The sky was perfectly clear from clouds during the whole day.

OOKIEP STATION.

Approximate longitude	$1^h\ 11^m\ 33^s$
Approximate south latitude......	29° 36′ 15″

This station was 3059 feet above the level of the sea. This height is derived from Mr. Hall's levelling. The instruments were placed as near Mr. Carson's house as would insure freedom from any disturbing effect of the iron about the house. Ookiep is surrounded by mountains, which impeded very early or late observations of the sun from the station chosen. It is the chief mining station, at present, of the Cape Copper-Mining Company.

Dip Observations.

			°	′	″
1874, April 18, 11^h.	A_2 South		53	9	58
	A_2 North		53	34	44
	Dip................	=	53	22	21

Deflections.

April 20, 3^h. Temperature 82°.

$$\text{Distance 1·0 foot}\left\{\begin{matrix} 10^\circ\ 52'\ 20'' \\ 10\ 50\ 50 \\ 10\ 52\ 46 \\ 10\ 56\ 29 \end{matrix}\right\} u = 10^\circ\ 53'\ 6''.$$

Vibrations.

April 20, $4^h\ 21^m$ P.M. Temperature 67°. $90p = 2'\ 50''$. $\tau_1 = 5^s{\cdot}0593$, $\tau_2 = 5^s{\cdot}0628$, $\tau = 5^s{\cdot}0611$; from which $X = 4{\cdot}4252$, $m = 0{\cdot}4262$.

Variation.

April 20, 5^h. Temperature 67°. $90p = 2'\ 50''$.

	°	′	″
Readings for the variation-magnet suspension.. {	229	3	40
	227	40	30
Reading for magnetic meridian	228	22	5
Reading for magnetic meridian, vibration-magnet .	228	23	12
Reading for chimney (2)	271	40	1
Excess of reading for chimney (2).............	43	17	56

An attempt was made to obtain another determination of the variation on April 22, but the thread broke during the observations.

April 23, 10^h. Temperature 82°.

	°	′	″
Readings for magnetic meridian suspension.... {	196	14	33
	194	50	50
Reading for magnetic meridian	195	32	42
,, Kokerboom	220	16	8
,, chimney (1)	237	19	36
,, chimney (2)	238	46	49

Excess of reading for Kokerboom	24°	43′	26″
,, ,, chimney (1)....	41	46	54
,, ,, chimney (2)....	43	14	7

The latitude was determined April 20, near noon.

Absolute azimuths of marks:—

		°	′	″
April 20.	Azimuth of Kokerboom	183	37	6
April 22.	,, ,, ...	183	35	36
	Azimuth of Kokerboom	183	36	21
April 20.	Chimney (2)..................	165	5	46
April 22.	Chimney (1)........	166	31	20

The two determinations of the azimuth of Kokerboom do not agree so closely as could be wished. I cannot find any thing wrong in the

reductions; and I fear that on one of the days (April 20 or 22) the theodolite must have been slightly disturbed in changing the sun-shade after the observations of the sun and before the observations of the marks. I am not, however, aware of any reason for assuming that such a disturbance actually did take place, and I have taken the mean of the two determinations as the true result.

		°	′	″	
Variation on April 20	....	165	5	46	
		43	17	56	
		208	23	42	or 28° 23′ 42″
Variation on April 22.	Kokerboom	183	36	21	
		24	43	26	
		208	19	47	or 28° 19′ 47″
	Chimney (2) ..	165	5	46	
		43	14	7	
		208	19	53	or 28° 19′ 53″
	Chimney (1) ..	166	31	20	
		41	46	54	
		208	18	14	or 28° 18′ 14″

Variation, April 22 .... 28° 19′ 18″

The results for the Ookiep station are:—

	°	′	″
Variation..........$V=$	28	21	30
Dip ....$D=$	53	22	21
Horizontal force ....$X=$	4·4252		
Magnetic moment ..$m=$	0·4262		
Total force ....$F=$	7·4171		

Orange-River Station.

Approximate longitude .... $1^h\ 12^m\ 56^s$

Approximate south latitude .... 28° 53′ 7″

The observations were made near New Raman's, Nisbetbath, or Schuyte drift. These three names are given to fix the particular drift to which reference is made. It was a narrow gorge, surrounded by mountains of some considerable height, some rising to 3000 and 4000 feet. The height of the station above the sea appeared, from barometrical determinations, to be about 780 feet. A mountain-pass, of about 750 feet, separated the river from the Bushman flats. These flats, in this neighbourhood,

appeared, from similar barometrical determinations, to be from 1500 to 1700 feet above the sea-level. The position was not altogether a favourable one for magnetical observations. I had but little choice of stations. I fear some little local magnetic disturbances in the observations made here, such that the elements might have been found to have differed somewhat considerably with a comparatively small shift in geographical position. I should therefore have been glad to have supplemented these observations with a set on the Bushman flats, the bed of a recent sea with numerous islands (kopies); but this could not have been done without proper arrangements for the supply of water.

Dip Observations.

		°	′	″
April 26, 9^h.	A_2 South	53	39	18
	A_2 North	54	0	14

Dip $=53° \ 49' \ 46''$,

a larger dip than that obtained at any other station by about $2'$.

The latitude was determined near noon.

Variation.

April 26, 1^h.

	°	′	″
Azimuthal reading of mark	266	33	45
Variation-magnet	351	26	45
	350	28	33
Reading for magnetical meridian	350	57	39
Reading with vibration-magnet	350	58	50
Azimuthal reading of mark repeated	266	34	0
Excess reading for the magnetic meridian	=84	23	46

Vibrations.

April 26, 2^h. Temperature 80°. $90p=6' \ 45''$.

Three threads were used for suspension at this station, but the torsion was carefully got rid of.

$$\tau_1=5^s{\cdot}0988, \ \tau_2=5^s{\cdot}0920, \ \tau=5^s{\cdot}0954.$$

Deflections.

April 27, 10^h. Temperature $79°{\cdot}5$.

$$\text{Distance } 1{\cdot}0 \text{ foot} \left\{\begin{array}{rrr} \overset{\circ}{10} & \overset{\prime}{59} & \overset{\prime\prime}{45} \\ 11 & 3 & 50 \\ 11 & 4 & 10 \\ 11 & 0 & 40 \end{array}\right\} u=11° \ 2' \ 6''.$$

Hence $X=4{\cdot}3798$, $m=0{\cdot}4271$.

The results for this station are:—

		°	′	″
Variation ....V=		28	27	24
Dip ....D=		53	49	46
Horizontal force ....X=	4·3798			
Magnetic moment ....m=	0·4271			
Total force ....F=	7·4210			

The numerous observations for time at the different stations have not been given, as of no interest.

I arrived in Namaqualand on April 9, by the Union steamship 'Namaqua,' Captain Barker, reached Port Nolloth, on my return, on the evening of Wednesday, April 29, but did not sail until Wednesday, May 6, reaching the observatory on Saturday, May 9.

XVI. "On the Proportions of the several Lobes of the Cerebrum in Man and in certain of the higher Vertebrata, and on an attempt to explain some of the Asymmetry of the Cerebral Convolutions in Man." By John Marshall, F.R.S., F.R.C.S.E., Professor of Surgery, University College, London, &c. Received June 17, 1875.

1. I desire to communicate to the Royal Society the fact that I have, by severing the cerebral hemispheres in certain definite directions in Man, and also in some of the higher Vertebrata, and by then weighing the separated portions, not only arrived at some interesting and important results as to the relative size of those portions in different animals and in Man, but I am enabled to state that this method, applied to the brains of individuals of different race, sex, age, education, and occupation, seems likely to furnish a means of investigating individual peculiarities in the human cerebrum.

I propose shortly to communicate my results to the Society.

2. I have likewise made numerous observations on the convolutions of the human brain with the view of explaining their symmetry in certain regions, and their asymmetry in others. In endeavouring to trace more particularly the causes of the asymmetry of the convolutions which prevails in Man, I have been led to believe that some, at least, of this is due to the right-handedness of Man.

I find, on studying a large number of human cerebra, that there are stronger evidences of *essential* asymmetry, as distinguished from what I would term *non-essential* asymmetry, in the immediate neighbourhood of the left fissure of Rolando, and next to this part in the right parietal lobule.

There are certain secondary essential asymmetrical conditions which may be pointed out, and besides this many non-essential and very variable ones.